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APRIORI ALGORITHM FOR IMPLEMENTATION OF RAW MATERIAL PURCHASE DATA ANALYSIS IN PT MAHAKAM BETA FARMA

Dewi Risdawati[1]; Nita Merlina[2*]

Information Systems Study Program [1, 2]
Sekolah Tinggi Manajemen Informatika dan Komputer Nusa Mandiri
www.nusamandiri.ac.id
[1]11170843@nusamandiri.ac.id; [2]nita@nusamandiri.ac.id
(*) Corresponding Author

Abstract—*PT Mahakam Beta Farma is a manufacturing company in the pharmaceutical field and there are obstacles in the storage of raw materials so that the process of entering and exiting raw materials is not effective. The solution to this problem is to rearrange the location of raw materials in the warehouse to facilitate the distribution of raw materials when entering or leaving so that when needed for the production process does not require much time in the search, which will also have an impact on the smooth production process. The basis for determining the layout of raw materials in the warehouse is to analyze what raw materials are often purchased at the same time for 1 year with data mining using apriori algorithm method. The application used to process the purchase of raw material that is large enough is Tanagra 1.4. The results of this study obtained 12 patterns of purchase of raw materials with a minimum value of 80% support, 90% minimum confidence, and lift ratio o as materials to recommend the re-layout of raw materials in the warehouse.*

Keywords: *Data Mining, Apriori Algorithm, Tanagra 1.4*

Abstrak— PT Mahakam Beta Farma merupakan perusahaan manufaktur dalam bidang farmasi dan terjadi kendala dalam penyimpanan bahan baku sehingga proses masuk dan keluar bahan baku tidak efektif. Solusi dari permasalahan ini adalah menata ulang letak bahan baku digudang agar dapat mempermudah pendistribusian bahan baku saat masuk ataupun keluar sehingga pada saat dibutuhkan untuk proses produksi tidak membutuhkan banyak waktu dalam pencarian, yang nantinya juga akan berdampak pada kelancaran proses produksi. Dasar untuk menentukan tata letak ulang bahan baku digudang yaitu dengan menganalisa bahan baku apa saja yang sering dibeli dalam waktu bersamaan selama 1 tahun dengan data mining menggunakan metode algoritma apriori. Aplikasi yang digunakan untuk mengolah data pembelian bahan baku yang cukup besar adalah dengan Tanagra 1.4. Hasil dari penelitian ini didapat 12 pola pembelian bahan baku dengan nilai minimum support 80%, minimum confidence 90% dan lift ratio o sebagai bahan untuk merekomendasi tata letak ulang bahan baku digudang.

Kata Kunci: Data Mining, Algoritma a priori, Tanagra 1.4

INTRODUCTION

To meet the needs of consumers, the manufacturing industry requires large quantities of raw materials. This results in the need for a good warehouse and storage system for the company. Before the sale, both finished goods and raw materials are stored in the warehouse. PT Mahakam Beta Farma is a manufacturing company in the pharmaceutical field and there are obstacles in the storage of raw materials so that the process of entering and exiting raw materials is not effective. Improper placement of raw materials can cause problems when needed for the production process. Besides that the product arrangement in the warehouse is not based on certain rules, it seems that the warehouse looks narrow and less tidy. Activities generally carried out relating to the layout of raw materials in the warehouse, are Receiving, Pre-packing, Put-away, Storage, Order picking, Packaging, Sortation and accumulation, Packing, and Shipping[1].

Storage of the wrong goods can have an impact on the process of activity at the warehouse, this will cause disturbances and losses such as the placement of goods in a narrow Hallway which will result in traffic in handling material goods in the warehouse and other things that also have an impact on the First In First Out queuing system (FIFO) goods as a procedure of entry and exit of goods so that it will result in the process of taking goods activities will take a long time[2]

The solution to these problems is to rearrange the location of raw materials in the warehouse to facilitate the distribution of raw materials when entering or leaving so that when needed for the production process does not require much time in the search, which will also have an impact on the smooth production process. The basis for determining the layout of raw materials in the warehouse is to analyze what raw materials are often purchased at the same time for 1 year with data mining using apriori algorithm method. The association rule technique which is part of the a priori algorithm technique has the function of finding all associative rules that meet the minimum requirements for support and confidence[3]. Data mining has the understanding according to [4] "which is a technique of digging up valuable information that is hidden or hidden in a data collection (database) so large that an interesting pattern was discovered that was previously unknown. " A priori algorithm is an algorithm that performs frequent itemset searches using the association rule technique, minimum for confidence (minimum confidence)[5]. This study aims to analyze the purchase of raw materials in 1 year by using apriori algorithm and obtained associational rules. So that it can be seen that raw materials are often purchased simultaneously for over 1 year.

MATERIALS AND METHODS

Methods and research are scientific ways to get data with the aim and usefulness of solving a problem[6]. Data collection is done by interviewing the process of direct conversation with several users with a specific purpose, the observation by making direct observations of the work process and careful recording to collect data and obtain the information needed [7], literature study by studying the source of reference originating from journals and books related to research.

Association analysis is also known as a data mining technique which is the basis of various other data mining techniques[8]. Especially one of the stages of association analysis called frequent pattern mining (analysis of frequent pattern mining) attracts the attention of many researchers to produce efficient algorithms. The importance of an association rule can be known by two parameters, support (supporting value), namely the percentage of the combination of items in the database and confidence (certainty value), namely the strong relationship between items in the association rules. Association analysis defined a process to find all association rules that met the minimum requirements for support (minimum support) and the minimum requirements for confidence (minimum confidence). The basic method of association analysis is divided into two stages:

1. Analyze high-frequency patterns
   This stage looks for combinations of items that meet the minimum requirements of the support value in the database. An item's support value is obtained by the following formula:

$$Support\ A = \frac{\text{Jumlah transaksi mengandung A}}{\text{Total Transaksi}}\ x\ 100\% \ldots\ldots\ (1)$$

While the support value of 2 items is obtained from the following formula:

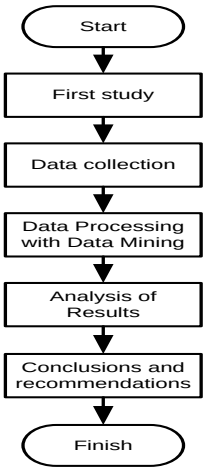
$$Support\ B = \frac{Jumlah\ transaksi\ mengandung\ A}{Total\ Transaksi}\ x\ 100\% \quad \ldots (2)$$

2. Formation of association rules
   After all high-frequency patterns have been found, then the associative rules are found that meet the minimum requirements for confidence by calculating the confidence of associative rules A → B, obtained from the following formula:

$$Confidence = P(B \mid A) = \frac{Jumlah\ transaksi\ mengandung\ A\ dan\ B}{Total\ Transaksi\ mengandung\ A}\ x\ 100\% \ldots\ldots\ldots\ldots\ (3)$$

Research Stages

The author uses systematic research stages to help the research to be well directed. The following stages of research carried out:



Source:[9]

Figure 1. Research Stages

Explanation of the research stages in Figure 1 above is:

1. Preliminary Study
   The initial step of this research is to look for and study the problems that exist in the company. Then determine the scope of the problem, the background of the problem, and study some

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literature related to the problem and find solutions to the problem.

2. Data Collection

Data collection is done by interviews, observations, and documentation in the Company. The process aims to obtain the information needed, in the form of raw material purchase data from January 2017 - December 2017.

3. Data processing with Data Mining

At the data processing stage, first, identify the problems that exist in the Company. The next step is to analyze the problem by collecting raw material purchasing data for 1 year to find a solution to the existing problem. Then the data mining technique is used with the apriori algorithm to find the support value and the confidence value of the final association rule.

4. Analysis of Results

Analysis of the results is done using Tanagra 1.4 and apriori algorithm to connect with the database using data obtained at the time of data collection.

5. Conclusions

Pattern calculation using apriori algorithm method produces a percentage of raw material purchase patterns that show the final results for the value of support and confidence.

RESULTS AND DISCUSSION

Processing raw material purchase data at PT Mahakam beta Farma required for annual reports are mostly still using excel, so the time needed to process the data until it becomes the desired report is quite long. Therefore the authors researched processing raw material purchase data with the apriori algorithm.

a. Purchase list of raw materials

Data on raw material purchases at PT Mahakam Beta Farma can be seen in Table 1 below:

Table 1. List of Raw Materials of PT Mahakam Beta Farma

No	Raw material
1	Astaxanthin 2.5% beadlets
2	Clopidogrel bisulfate
3	Collactive
4	Ethyl alcohol
5	Glycerine
6	Lactose monohydrate
7	Meropenem-sod. Carbonate
8	Methylprednisolone
9	Mg stearate pharma grade
10	Microcrystalline cellulose 102
11	N-acetylcysteine
12	Pantoprazole sod sesquihidrate
13	Pioglitazone HCL
14	Polyethylene glycol
15	Polyethylene glycol 4000
16	Rhodapex co
17	Sod.hyd.phosphate
18	Sodium hydroxide pellets pure 6482.9050
19	Sorbitol liquid 70/70 + coa
20	Sucralfate micronized

Source: [10]

b. A pattern of Purchasing Raw Materials

Purchases of raw materials from the January-December 2017 period are in table 2 below:

Table 2. A pattern of Purchasing Raw Materials

Month	Raw material
1	Astaxanthin 2.5% beadlets, Clopidogrel bisulfate, Ethyl alcohol, Glycerine, Lactose monohydrate, Meropenem-sod. Carbonate, Methylprednisolone, Mg stearate pharma grade, Pantoprazole sod sesquihydrate, Polyethylene glycol, Sod.hyd.phosphate, Sucralfate micronized
2	Astaxanthin 2.5% beadlets, Clopidogrel bisulfate, Ethyl alcohol, Glycerine, Lactose monohydrate, Methylprednisolone, Mg stearate pharma grade, Microcrystalline cellulose 102, Pioglitazone HCL, Polyethylene glycol, Sod.hyd.phosphate, Sucralfate micronized
3	Astaxanthin 2.5% beadlets, Collactive, Ethyl alcohol, Glycerine, Methylprednisolone, Polyethylene glycol, Sorbitol liquid 70/70 + coa, Sucralfate micronized
4	Ethyl alcohol, Glycerine, Lactose monohydrate, Meropenem-sod. Carbonate, Methylprednisolone, Mg stearate pharma grade, Microcrystalline cellulose 102, N-acetylcysteine, Pantoprazole sod sesquihydrate, Polyethylene glycol, Sod.hyd.phosphate, Sorbitol liquid 70/70 + coa
5	Ethyl alcohol, Glycerine, Lactose monohydrate, Methylprednisolone, Microcrystalline cellulose 102, Pioglitazone HCL, Polyethylene glycol, Polyethylene glycol 4000, Sod.hyd.phosphate, Sodium hydroxide pellets pure 6482.9050, Sorbitol liquid 70/70 + coa, Sucralfate micronized
6	Ethyl alcohol, Glycerine, Meropenem-sod. Carbonate, Methylprednisolone, Mg stearate pharma grade, Microcrystalline cellulose 102, Pantoprazole sod sesquihydrate, Pioglitazone HCL, Polyethylene glycol, Sod.hyd.phosphate, Sodium hydroxide pellets pure 6482.9050, Sorbitol liquid 70/70 + coa,
7	Ethyl alcohol, Glycerine, Meropenem-sod. Carbonate, Methylprednisolone, Mg stearate pharma grade, Microcrystalline cellulose 102, N-acetylcysteine, Pantoprazole sod sesquihydrate, Pioglitazone hcl, Polyethylene glycol, Polyethylene glycol 4000, Sod.hyd.phosphate, Sodium hydroxide pellets pure 6482.9050, Sucralfate micronized
8	Ethyl Alcohol, Glycerine, Lactose monohydrate, Meropenem-sod. Carbonate, Methylprednisolone, Mg stearate pharma grade, Microcrystalline cellulose 102, N-acetylcysteine, Pantoprazole sod sesquihydrate, Pioglitazone HCL, Polyethylene glycol, Polyethylene glycol 4000, Rhodapex co, Sod.hyd.phosphate, Sucralfate micronized
9	Ethyl Alcohol, Lactose monohydrate, Meropenem-sod. Carbonate, Methylprednisolone, Microcrystalline cellulose 102, N-acetylcysteine, Pioglitazone hcl, Polyethylene glycol, Polyethylene glycol 4000, Rhodapex co, Sucralfate micronized
10	Ethyl Alcohol, Glycerine, Lactose monohydrate, Methylprednisolone, N-acetylcysteine, Pantoprazole sod sesquihydrate, Polyethylene glycol, Polyethylene glycol 4000, Rhodapex co, Sod.hyd.phosphate,

Month	Raw material
	Sucralfate micronized
11	Ethyl Alcohol, Glycerine, Methylprednisolone, Mg stearate pharma grade, Pioglitazone hcl, Rhodapex co, Sod.hyd.phosphate, Sodium hydroxide pellets pure 6482.9050
12	Glycerine, Lactose Monohydrate, Methylprednisolone, Microcrystalline cellulose 102, Rhodapex co, Sod.hyd.phosphate

Source: [10]

c. Making Tabular Format

The tabular format of raw material purchase data formed from the 20 transactions taken the most from the period of January to December 2017.

d. Analysis of High-Frequency Patterns

1. Formation of 1 Itemset

The process of forming C1 or also called an itemset with a minimum support = 80%. Obtained by the formula:

$$Support\ (A) = \frac{\sum Transaksi\ yang\ mengandung\ A}{\sum Transaksi}\ x\ 100\% \quad .....(4)$$

The minimum support value for C1 = 80%, then table 3 is made below to remove C1 that does not meet the minimum support:

Table 3 Itemset with a minimum Support of 80%

Item Set	Jumlah	Support
Ethyl alcohol	11	91.7%
Glycerine	11	91.7%
Methylprednisolone	12	100.0%
Polyethylene glycol	10	83.3%
Sod.hyd.phosphate	10	83.3%

Source : [10]

2. Combination of 2 items set

The process of forming C2 or also called 2 itemsets is obtained by the formula:

$$Support\ (A,B) = \frac{\sum Transaksi\ yang\ mengandung\ A,B}{\sum Transaksi}\ x\ 100\% \quad .....(5)$$

The following calculation of the formation of C2:

Minimum Support is set at 80%, so a combination of 2 itemsets that does not meet the minimum support will be removed. Looks like the following table 4:

Table 4. Itemset with a Minimum Support of 80%

Item Set	Total	Support
Ethyl alcohol, Glycerine, Methylprednisolone	10	83,3%
Ethyl alcohol, Methylprednisolone, Polyethylene glycol	10	83,3%
Glycerine,Methylprednisolone,Sod. hyd.phosphate	10	83,3%

Source: [10]

3. Combination of 3 itemset

The process of forming C3 or also called with 3 itemsets can be completed with the following formula:

$$Support\ (A,B\ dan\ C) = \frac{\sum Transaksi\ yang\ mengandung\ A,B,C}{\sum Transaksi}\ x\ 100\% \quad .....(6)$$

Minimum Support is set at 80%, so a combination of 3 itemsets that does not meet the minimum support will be removed. Looks like the following table 5:

Table 5 Itemset with a Minimum Support of 80%

Item Set	Total	Support
Ethyl alcohol,Glycerine	10	83.3%
Ethyl alcohol, Methylprednisolone	11	91.7%
Ethyl alcohol, Polyethylene glycol	10	83.3%
Glycerine, Methylprednisolone	11	91.7%
Glycerine,Sod.hyd.phosphate	10	83.3%
Methylprednisolone, Polyethylene glycol	10	83.3%
Methylprednisolone,Sod.hyd.phosphate	10	83.3%

Source : [10]

4. Formation of Association Rules

After all high-frequency patterns have been found, new association rules are found that meet the minimum confidence requirement by calculating the confidence rules of association A → B, with a minimum confidence = 90%.

The confidence value of the rules A → B is obtained by the following formula:

$$\text{Confidence} = \text{CP}(B|A) = \frac{\sum Transaksi\ yang\ mengandung\ A,B}{\sum Transaksi\ A}\ x\ 100\% \quad .....(7)$$

In the previous table 6, a final association candidate was obtained based on a combination of 2 itemsets with minimum support of 80%. Prospective final association rules that do not meet the minimum support value = 80% and the minimum confidence value = 90% will be eliminated. So that the prospective association rules that serve as the final association rules can be seen in the following table 6:

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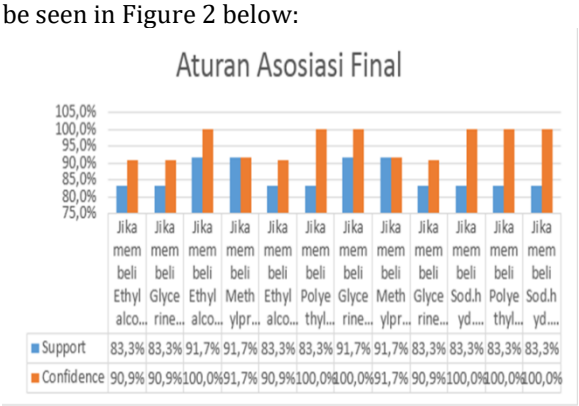
Table 6. Final Association Rules

Final Association Rules	Support	Confidence
Jika membeli Ethyl alcohol maka akan membeli Glycerine	83,3%	90,9%
Jika membeli Glycerine maka akan membeli Ethyl alcohol	83,3%	90,9%
Jika membeli Ethyl alcohol maka akan membeli Methylprednisolone	91,7%	100,0%
Jika membeli Methylprednisolone maka akan membeli Ethyl alcohol	91,7%	91,7%
Jika membeli Ethyl alcohol maka akan membeli Polyethylene glycol	83,3%	90,9%
Jika membeli Polyethylene glycol maka akan membeli Ethyl alcohol	83,3%	100,0%
Jika membeli Glycerine maka akan membeli Methylprednisolone	91,7%	100,0%
Jika membeli Methylprednisolone maka akan membeli Glycerine	91,7%	91,7%
Jika membeli Glycerine maka akan membeli Sod.hyd.phosphate	83,3%	90,9%
Jika membeli Sod.hyd.phosphate maka akan membeli Glycerine	83,3%	100,0%
Jika membeli Polyethylene glycol maka akan membeli Methylprednisolone	83,3%	100,0%
Jika membeli Sod.hyd.phosphate maka akan membeli Methylprednisolone	83,3%	100,0%

Source : [10]

Based on Table 7. above, it can be seen that the purchase of raw materials that have experienced many transactions at PT Mahakam Beta Farma can be seen in Figure 2 below:



Source : [10]

Figure 2. Diagram of Final Association Rules for Purchasing Raw Materials

That way it can be seen for each raw material that has a minimum value of 80% support and a minimum value of 90% confidence so that the results of the study can be used to regulate the placement in the storage of purchased raw materials so that when the process of entering and leaving raw materials in the warehouse is more effective and efficient and can help smooth production.

The location of the storage of raw materials can be done by prioritizing raw materials which has a high confidence value is placed close together. Then the raw material that has a high support value will be placed at the end/beginning because the raw material will be made a lot of purchases and requests for the production process.

CONCLUSION

The results of research conducted with the apriori algorithm using the Tanagra application can handle the processing of raw material purchase data which is quite a lot so that a percentage of raw material purchase patterns are obtained. The percentage obtained If making an Ethyl alcohol purchase will be accompanied by a Glycerine purchase having a support value of 83.3% and a value of 100% confidence. If you buy Glycerine, Ethyl alcohol will have a support value of 83.3% and a confidence value of 90.9%. If you buy Ethyl alcohol, it will be accompanied by a purchase of Methylprednisolone which has a support value of 91.7% and a confidence value of 100%. If you buy Methylprednisolone, Ethyl alcohol will have a support value of 91.7% and a confidence value of 91.7%. If you buy Ethyl alcohol it will be accompanied by the purchase of Polyethylene glycol which has a support value of 83.3% and a confidence value of 90.9%. If you buy Polyethylene glycol, it will be accompanied by a purchase. Ethyl alcohol has a support value of 83.3% and 100% confidence value. If you buy Glycerine, it will be accompanied by a purchase of Methylprednisolone which has a support value of 91.7% and a confidence value of 100%. If you buy Methylprednisolone it will be accompanied by a Glycerine purchase that has a support value of 91.7% and a confidence value of 91.7%. If you buy Glycerine, it will be accompanied by the purchase of Sod.hyd.phosphate which has a support value of 83.3% and a confidence value of 90.9%. If you make a Sod.hyd.phosphate purchase, a Glycerine purchase will have a support value of 83.3% and a confidence value of 100%. If you buy Polyethylene glycol, it will be accompanied by the purchase of Methylprednisolone which has a support value of 83.3% and a 100% confidence value. If you buy Polyethylene glycol, it will be accompanied by the purchase of Methylprednisolone which has a support value of 83.3% and a 100% confidence value.

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